TITLE: COHERENT DOPPLER LIDAR FOR AUTOMATED SPACE VEHICLE, RENDEZVOUS, STATION-KEEPING AND CAPTURE

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ABSTRACT:

A number of studies dating back as early as the late 1960's have documented the potential of lidar as an enabling technology for automated space vehicle rendezvous, and capture. Few of these studies considered the use of coherent lidar. Coherent lidars are lidars which incorporate lasers with line widths narrow enough to permit direct measurement of velocity via doppler shift. Although coherent lidar has been used for ground based atmospheric velocity measurements for over twenty years, the technology involved CO_2 gas lasers, which because of problems with packaging and consumables, were not well suited to rendezvous and capture applications.

Recent advances in eye-safe, short wavelength solid-state lasers offer real potential for the development of compact, reliable, light-weight, efficient coherent lidar. Laser diode pumping of these devices has been demonstrated, thereby eliminating the need for flash lamp pumping, which has been a major drawback to the use of these lasers in space based applications. Also these lasers now have the frequency stability required to make them useful in coherent lidar, which offers all of the advantages of non-coherent lidar, but with the additional advantage that direct determination of target velocity is possible by measurement of the doppler shift. By combining the doppler velocity measurement capability with the inherent high angular resolution and range accuracy of lidar it is possible to construct doppler images of targets for target motion assessment.

A coherent lidar based on a Tm,Ho:YAG 2-micrometer wavelength laser was constructed and successfully field tested on atmospheric targets in 1990. This lidar incorporated an all solid state (laser diode pumped) master oscillator, in conjunction with a flash lamp pumped slave oscillator. Solid- state laser technology is rapidly advancing, and with the advent of high efficiency, high power, semiconductor laser diodes as pump sources, all-solid-state, coherent lidars are a real possibility in the near future.

MSFC currently has a feasibility demonstration effort under way which will involve component testing, and preliminary design of an all-solid-state, coherent lidar for automatic rendezvous, and capture. This two year effort, funded by the Director's Discretionary Fund is due for completion in 1992.